100 years (the same as Scenario 1). Beyond that time, the scenario assumes no effective institutional control. Therefore, after about 100 years and up to 10,000 years, the analysis assumed that the spent nuclear fuel and high-level radioactive waste storage facilities at 72 commercial and 5 DOE sites would begin to deteriorate and that the radioactive materials in them could eventually be released to the environment. DOE based the choice of 100 years on a review of generally applicable Environmental Protection Agency regulations for the disposal of spent nuclear fuel and high-level radioactive waste (40 CFR Part 191, Subpart B), Nuclear Regulatory Commission regulations for the disposal of low-level radioactive material (10 CFR Part 61), and a National Research Council report on standards for the proposed Yucca Mountain Repository that generally discounts the consideration of institutional control for longer periods in performance assessments for geologic repositories (DIRS 100018-National Research Council 1995, Chapter 4). The lower portion of Figure 2-36 shows the conceptual timeline for activities at the storage facilities for Scenario 2.

2.2.3 NO-ACTION ALTERNATIVE COSTS

The total estimated cost of the No-Action Alternative includes costs for the decommissioning and reclamation of the Yucca Mountain site, and for the storage of spent nuclear fuel at 72 commercial sites (63,000 MTHM), storage of DOE spent nuclear fuel (2,333 MTHM) at 4 sites (there would be no spent nuclear fuel at the West Valley Demonstration Project), and storage of solidified high-level radioactive waste (8,315 canisters) at 4 sites (there is no high-level radioactive waste at Fort St. Vrain). As listed in Table 2-6, the estimated cost (in 2001 dollars) of both Scenarios 1 and 2 for the first 100 years ranges from $55.7 billion to $61.3 billion, depending on whether the dry storage canisters had to be replaced every 100 years. The estimated costs (in 2001 dollars) for the remaining 9,900 years of Scenario 1 range from $519 million to $572 million per year. There would be no costs for Scenario 2 after the first 100 years because the scenario assumes no effective institutional control.

Table 2-6. No-Action Alternative life-cycle costs (starting in 2002) for 10,000 years (in billions of 2001 dollars).[a,b]

	First 100 years	Remaining 9,900 years (per year)	
Factor	Scenarios 1 and 2[c]	Scenario 1[c,d]	Scenario 2[e]
72 commercial sites (63,000 MTHM)	$43.6 - 49.2	$0.407 - 0.460	$0
DOE spent nuclear fuel storage sites (2,333 MTHM)	8.0	0.075	0
High-level radioactive waste storage sites (8,315 canisters)	4.1	0.038	0
Decommissioning and reclamation of the Yucca Mountain site	(f)	NA[g]	0
Totals	***$55.7 - 61.3***	***$0.519 - 0.572***	***$0***

a. Source: Adapted from DIRS 155929-Jason (1999, all).
b. Adjusted to 2001 dollars, in billions per DIRS 156899-DOE (2001, all).
c. The range of costs for commercial sites is based on the assumption that the spent nuclear fuel would either be placed in dry storage canisters that would not need to be replaced over the 10,000-year period (low cost) or would have to be placed in new dry storage canisters every 100 years (high cost).
d. Stewardship costs are expressed in average annual disbursement costs (year 2001 dollars) only.
e. Costs are not applicable.
f. The costs for decommissioning and reclamation of the Yucca Mountain site would contribute less than 0.1 percent to the total life-cycle cost of continued storage.
g. NA = not applicable.

2.3 Alternatives Considered but Eliminated from Detailed Study

This section addresses alternatives that DOE considered but eliminated from detailed study in this EIS. These include alternatives that the NWPA states this EIS need not consider (Section 2.3.1); design alternatives that DOE considered but eliminated during the evolution of the repository design analyzed in this EIS (Section 2.3.2); and alternative rail corridors and highway routes for heavy-haul trucks and

associated intermodal transfer station locations that DOE considered but eliminated during the transportation studies that identified the 10 Nevada implementing rail and intermodal alternatives analyzed in this EIS (Section 2.3.3).

2.3.1 ALTERNATIVES ADDRESSED UNDER THE NUCLEAR WASTE POLICY ACT

The NWPA states that, with respect to the requirements imposed by the National Environmental Policy Act, compliance with the procedures and requirements of the NWPA shall be deemed adequate consideration of the need for a repository, the time of the initial availability of a repository, and all alternatives to the isolation of spent nuclear fuel and high-level radioactive waste in a repository [Section 114(f)(2)]. The geologic disposal of radioactive waste has been the focus of scientific research for more than 40 years. Starting in the 1950s, the Atomic Energy Commission and the Energy Research and Development Administration (both predecessor agencies to DOE) investigated different geologic formations as potential hosts for repositories and considered different disposal concepts, including deep-seabed disposal, disposal in the polar ice sheets, and rocketing waste into the sun. After extensive discussion of the options in an EIS (DIRS 104832-DOE 1980, all), DOE decided in 1981 to pursue disposal in an underground mined geologic repository (46 *FR* 26677; May 14, 1981). A panel of the National Academy of Sciences noted in 1990 that there is a worldwide scientific consensus that deep geologic disposal, the approach being followed by the United States, is the best option for disposing of high-level radioactive waste (DIRS 100061-National Research Council 1990, all).

Chapter 1 of this EIS summarizes the process that led to the 1987 amendments to the Nuclear Waste Policy Act of 1982, in which Congress directed DOE to study only Yucca Mountain to determine if it is suitable for a repository. Consistent with this approach, the NWPA states that, for purposes of complying with the requirements of the National Environmental Policy Act, DOE need not consider alternative sites to Yucca Mountain for the repository [Section 114(f)(3)].

Under the Proposed Action, this EIS does not consider alternatives for the emplacement of more than 70,000 MTHM of spent nuclear fuel and high-level radioactive waste in a repository at Yucca Mountain because the NWPA prohibits the Nuclear Regulatory Commission from approving the emplacement in the first repository of a quantity of spent nuclear fuel containing more than 70,000 MTHM or a quantity of solidified high-level radioactive waste resulting from the reprocessing of such a quantity of spent nuclear fuel until a second repository is in operation [Section 114(d)]. However, Chapter 8 of this EIS analyzes the cumulative impacts from the disposal of all projected spent nuclear fuel and high-level radioactive waste, as well as Greater-Than-Class-C waste and Special-Performance-Assessment-Required waste in the proposed Yucca Mountain Repository.

2.3.2 REPOSITORY DESIGN ALTERNATIVES ELIMINATED FROM DETAILED STUDY

The preliminary design concept for the proposed Yucca Mountain Repository analyzed in this EIS is the result of a design process that began with early site characterization activities. The design process identified design alternatives (options) that DOE considered. Some of the design options were eliminated from further detailed study during the design evolution. Examples include placement of the emplacement drifts in the *saturated zone* (rather than the *unsaturated zone*); vertical shafts (rather than the gently sloping North and South Ramps); use of drilling and blasting methods for emplacement drift construction (rather than mechanical excavation methods such as tunnel-boring machines); and use of diesel-powered vehicles for waste package emplacement (rather than electrically powered, rail-based vehicles).

DOE recently undertook a comprehensive review and examination of possible design options to provide information for use in support of the suitability recommendation and License Application. Appendix E discusses the design options that DOE considered in this review, and Section 2.1.1.5 discusses their consideration in this EIS.

2.3.3 TRANSPORTATION ALTERNATIVES ELIMINATED FROM DETAILED STUDY

The transportation modes and scenarios analyzed in the EIS are based on DOE's assessment of what would be most feasible and practical for delivering spent nuclear fuel and high-level radioactive waste from generator sites across the continental United States to a repository at Yucca Mountain.

In response to public comments on the Draft EIS, DOE has evaluated the potential for including a large-scale barge scenario and a different mostly rail scenario in which railcars would be used to transport truck casks containing spent nuclear fuel and high-level radioactive waste. The purported advantage of large-scale use of barge transportation was that it would reduce the amount of cross-country overland travel that would be required. However, DOE eliminated the barge modal scenario from further consideration in the EIS because it would be overly complex, requiring greater logistical complexity than either rail or legal-weight truck transportation; a much greater number of large rail casks than rail transport; much greater cost than either rail or legal-weight truck transportation; long transport distances potentially requiring the transit of the Panama Canal outside U.S. territorial waters; transport on intercoastal and coastal waterways of coastal states and on major rivers through and bordering states; extended transportation times; intermodal transfer operations at ports; and land transport from a western port to Yucca Mountain.

DOE also eliminated the truck-cask-on-railcar modal scenarios from future consideration. In this scenario, legal-weight truck casks would be shipped by rail from generator sites to Nevada and then by legal-weight trucks in the State to a Yucca Mountain repository. The purported advantage of this scenario is that DOE could use rail transportation nationally and would not have to construct and operate a branch rail line or upgrade highways, construct an intermodal transfer station, and use heavy-haul trucks in Nevada. DOE determined that while this scenario would be feasible, it would not be practical. The number of shipping casks and railcar shipments would be greater by a factor of 5 than for the mostly rail scenario and the additional cost to the Program would be more than $1 billion. In addition, the truck-casks-on-railcars scenario would lead to the highest estimates of occupational health and public health and safety impacts, most coming from rail-traffic related facilities.

For these reasons, DOE selected the mostly rail and mostly legal-weight truck transportation scenarios as the basis to estimate impacts of transporting spent nuclear fuel to a Yucca Mountain repository. It also evaluated use of barge transportation as a component of the mostly rail scenario for transporting rail casks to nearby railheads from generator sites that could load a rail cask and that are located near navigable waterways but are not served by railroads.

2.3.3.1 Potential Rail Routes Considered but Eliminated from Further Detailed Study

Because rail access is not currently available to the Yucca Mountain site, DOE would have to build a branch rail line from an existing mainline railroad to the repository or transfer rail shipping casks to heavy-haul trucks at an intermodal transfer station to make effective use of rail transportation for shipping spent nuclear fuel and high-level radioactive waste to the repository. Section 2.1.3 describes the 10 implementing rail and intermodal alternatives for Nevada transportation that this EIS evaluates. DOE selected these implementing alternatives based on transportation studies that identified, evaluated, and eliminated other potential Nevada transportation rail and intermodal alternatives (DIRS 104792-YMP 1990, all; DIRS 104795-CRWMS M&O 1995, all; DIRS 101214-CRWMS M&O 1996, all). This section identifies the potential rail and highway routes for heavy-haul trucks and associated intermodal transfer station locations that DOE considered but eliminated from further detailed study.

In the *Preliminary Rail Access Study* (DIRS 104792-YMP 1990, all), DOE identified 10 potential branch rail line routes to the Yucca Mountain site (Valley, Arden, Jean, Crucero, Ludlow, Mina, Caliente, Carlin, Cherry Creek, and Dike). Figure 2-37 shows these potential rail routes, each named for the area where it would connect to the mainline railroad. Alternatives within each route were developed wherever

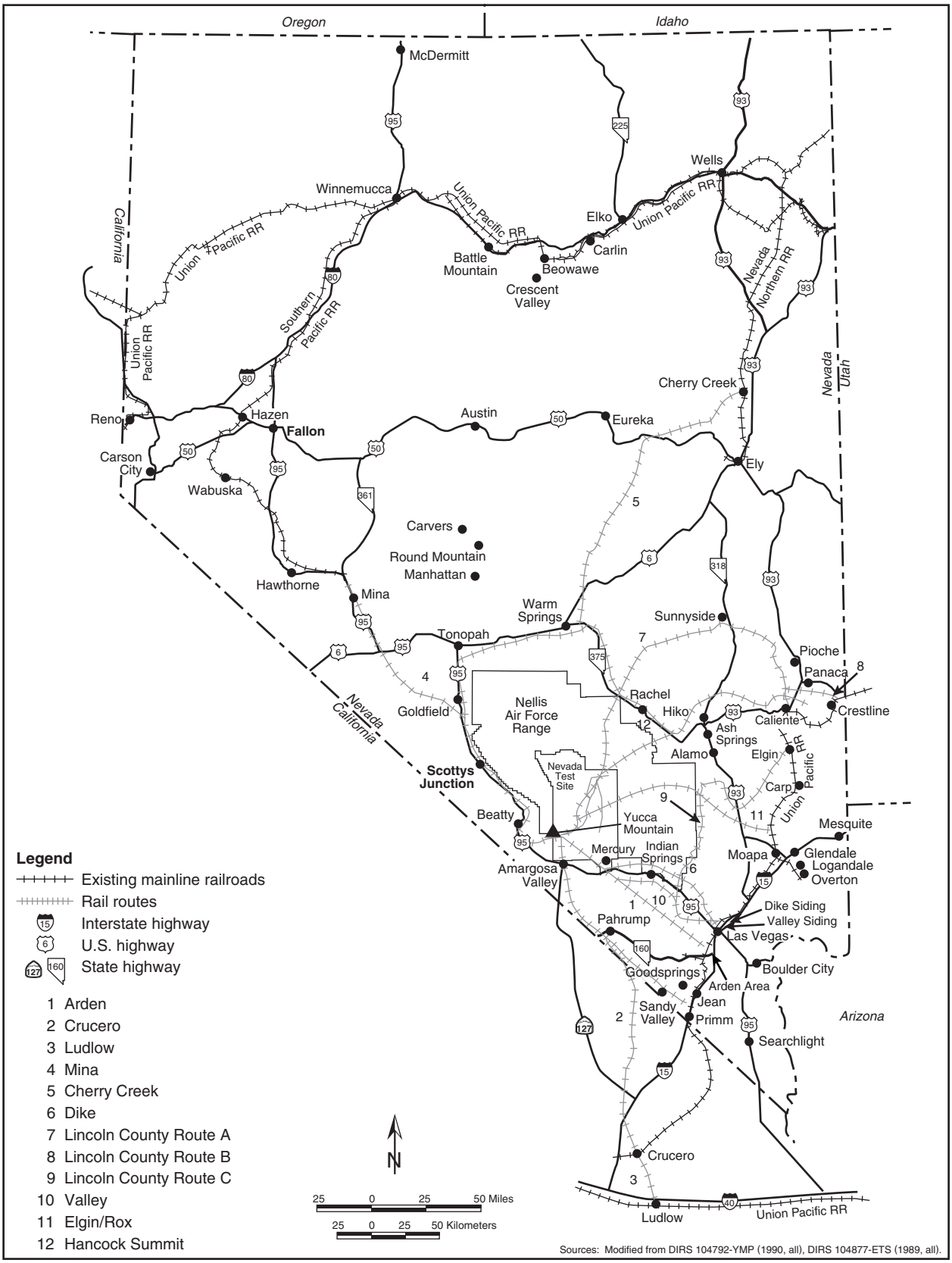


Figure 2-37. Potential rail routes to Yucca Mountain, Nevada, considered but eliminated from further study.

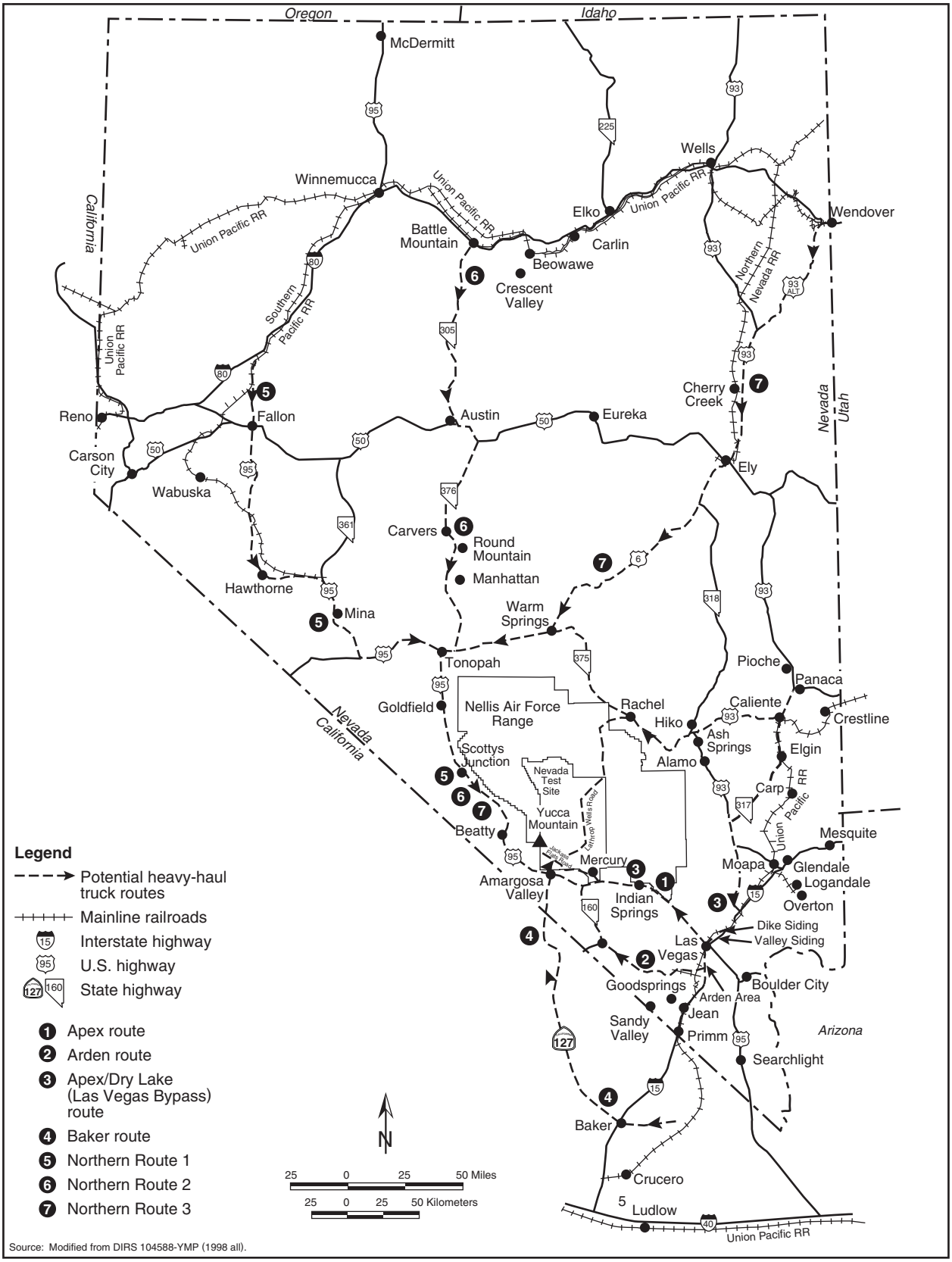
possible. The routes were chosen to maximize the use of Federal lands, provide access to regional rail carriers, avoid obvious land-use conflicts, and meet current railroad engineering practices. After the development of these rail routes, Lincoln County and the City of Caliente identified three additional routes (identified as Lincoln County Routes A, B, and C).

DOE evaluated these 13 potential rail routes in DIRS 104792-YMP (1990, all) and reevaluated them in the *Nevada Potential Repository Preliminary Transportation Strategy, Study 1* (DIRS 104795-CRWMS M&O 1995, all). One new route, Valley Modified, was added in the 1995 study based on updated information from the Bureau of Land Management on the status of two Wilderness Study Areas that represent possible land-use conflicts for the Valley route in the original evaluation. Three additional alignments—Caliente-Chalk Mountain, Elgin/Rox, and Hancock Summit—were evaluated in the Nevada Potential Repository Preliminary Assessment of the Caliente-Chalk Mountain Rail Corridor. The evaluations reviewed each potential rail corridor to identify land-use compatibility issues (the presence or absence of land-use conflicts, and the potential for mitigation of a conflict if one exists) and for access to regional rail carriers. The evaluations also compared other factors of the routes, including favorable topography (gently sloping rather than rugged terrain) and avoidance of lands withdrawn from public use by Federal action. Based on these evaluations, DOE eliminated the Valley, Arden, Crucero, Ludlow, Mina, Cherry Creek, Dike, Elgin/Rox, Hancock Summit, and Lincoln County A, B, and C rail routes from further study.

2.3.3.2 Potential Highway Routes for Heavy-Haul Trucks and Associated Intermodal Transfer Station Locations Considered but Eliminated from Further Detailed Study

DOE identified and evaluated potential highway routes for heavy-haul trucks from existing mainline railroads to the Yucca Mountain site (DIRS 104795-CRWMS M&O 1995, all; DIRS 101214-CRWMS M&O 1996, all; DIRS 154448-CRWMS M&O 1998, all). The Department identified highway routes for heavy-haul trucks and associated intermodal transfer station locations to provide reasonable access to existing mainline railroads, to minimize transport length from an existing mainline rail interchange point, and to maximize the use of roads identified by the Nevada Department of Transportation for the highest allowable axle load limits. In addition to the five implementing intermodal alternatives selected for analysis in this EIS (see Section 2.1.3.3), Figure 2-38 shows highway routes for heavy-haul trucks and associated intermodal transfer station locations that DOE considered but eliminated from further detailed study. The eliminated alternatives include four routes named for the location of the intermodal transfer station—Apex, Arden, Baker, and Apex/Dry Lake (Las Vegas Bypass)—and three that are representative of routes from the northern Union Pacific mainline railroad (Northern Routes 1, 2, and 3).

DOE considered the development of new roads for dedicated heavy-haul truck shipments. The analysis assumed those routes would be within the corridors identified for potential rail routes, because the selection criteria for heavy-haul routes and rail routes (land-use compatibility issues, access to regional rail carriers, etc.) would be similar (DIRS 101214-CRWMS M&O 1996, p. 6-3). DOE also considered routes for heavy-haul trucks in the potential rail corridors that could use portions of the existing road system for part of the route length. DOE eliminated the development of a new road for heavy-haul trucks from further detailed evaluation, because the construction of a new branch rail line would be only slightly more expensive and because transportation by rail would not require intermodal transfers and would be more efficient (DIRS 101214-CRWMS M&O 1996, p. 6-7).



Source: Modified from DIRS 104588-YMP (1998 all).

Figure 2-38. Potential highway routes for heavy-haul trucks to Yucca Mountain, Nevada, considered but eliminated from further study.